Development of an Efficient Biodegradation System for Solid Waste Composting using Indigenous Microorganisms.

By

H.M.M.Herath

A thesis was submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Philosophy (Research) in Solid Waste Management

Research work supervised by

Mr. S. Pathinather

Dr S.C Wijerathne

Department of Civil Engineering

University of Moratuwa

Moratuwa

Sri Lanka

February 2004

Abstract.

This thesis describes a study conducted to produce compost using vegetable market garbage, as the main ingredient .The main objective was to reduce the time of production and to produce good quality compost by inoculation and aeration. Low cost windrow method was used under indoor environmental conditions where six different types of treatment were studied, each lasting eight weeks.

The experimental heap was 1.5m X 1.5m x 1m (length X width X height) and a hollow triangular wooden frame 1.5 m X 0.3m X 0.3m (length X width X height) was used to facilitate aeration. Initial weight of the feedstock was 250 kg and the heap was turned once a week. The first trial was carried out using 80% market garbage, 10% cow dung, 5% sawdust and 5% coir dust. For subsequent experiments the composition used was 50% market garbage, 10% cowdung10% saw dust 5% coir dust and 25 % air-dried grass clippings. Mature compost 2.5 % and 5 % were used as inoculum in the third and fourth runs respectively. The fifth run was conducted without turning the heap and the sixth one without the frame for aeration and also without turning the heap.

Physical chemical and biological changes were determined during the composting process to evaluate the effectiveness of the process. Enzymatic activity of microorganisms, which were active during the composting process, was also studied. Seed germination in the final compost was tested by introducing *Raphanus* sp seeds.

The results indicated that a weight reduction of 50% occurred and the high temperature recorded during the initial stages helped to reduce pathogen and weeds. Diverse and dense indigenous beneficial microorganisms were present and macro organisms played an important role in reducing the particle size. Turning the windrows for aeration and addition of matured compost was found to accelerate the rate of composting. Use of 5% mature compost gave a higher rate of composting than 2.5%.

From determinations of temperature, C/N ratio CO_2 production, pH bulk density and seed germination it was concluded that when the process is properly controlled good quality compost can be obtained in about eight weeks.

Acknowledgment

This is to express my deep sense gratitude to all those who have helped me to complete this research project successfully.

I wish to extend my deep gratitude and sincere thanks to my supervisors, Mr S. Pathinather, Senior lecturer, Department of Civil Engineering, University of Moratuwa and Dr (Mrs) S.Chandrani Wijerathna, Senior lecturer ,Department of Botany University of Sri Jayawardanepura for their constant support and valuable guidance given to me at all times during this study.

Gratitude also extended to Professor (Mrs) N. Ratnayake, Director Post graduate studies Faculty of Engineering, University of Moratuwa, for her invaluable advises and comments, which encouraged me to succesfully, complete this study.

A special vote of thanks goes to the Dr Sumith Pilapitiya for his generous contribution to make this study a success.

I would like to thank to Dr Ravindra Lokupitiya Senior lecturer Department of Mathematics University of Moratuwa for helping me with statistical analysis.

I wish to thank Dr Mahesh Jayaweera, Senior lecturer Department of Civil Engineering University of Moratuwa giving me necessary assistance during the study period.

Appreciation is also extended to the help and support and guidance given by Dr Ajith de Alwis Senior lecturer, Department of Chemical Engineering, University of Moratuwa.

I am grateful to Dr. Ben Basnayake, Faculty of Agriculture and Dr Werallagama, Faculty of Engineering, University of Peradeniya for giving literature during the study.

My sincere gratitude is extended to Miss Priyanka Dissanayake Mrs Nilanthi Gunethilake, and Mr Justin Silva, Environmental Engineering division Department of Civil Engineering, University of Moratuwa for helping me in many different ways and their willing to support me at any time.

I would like to thank all members of the staff, department of Civil Engineering University of Moratuwa who helped me in various ways.

I would like to thank all the members of the staff, Department of Botany University of Sri Jayawardenapura, who supports me to complete the study.

I wish to extremely thank to Dr Tom Richard, Department of Agricultural and Bio systems Engineering, Iowa State University, USA, and Professor Lionel Martin, University of Curtin, Australia for giving literature and information.

I wish to thank all the members of Department of Town and Country Planning, University of Moratuwa, for giving me the permission and encouragement to complete this work.

I would like to extend my gratitude to the Asian Development Bank (ADB) for providing financial aid.

I thank to my colleagues, Neetha, Dilani Lashan, Aruna, Chamika and Sudesh for their feedback and pushing me towards my final goal. Especially, I would like to give my special thanks to my husband Kosala whose patient love enabled me to complete this work. Finally I thank to my mother, sister, brother and sister in low for their constant encouragement and support.

This Thesis is dedicated to my loving Father; it has been a greatest honour being your daughter.

Contents

CHAPTER FOUR: RESULTS

CHAPTER FIVE: DISCUSSION.

Figures

Tables

Declaration

The Thesis is a report of research work carried out in the Department of Civil Engineering, University of Moratuwa, Sri Lanka between March 2000 and March 2002. The work included in the thesis in part or whole has not been submitted for any other academic qualification at any institution.

.....

H.M.M.Herath
Department of Civil Engineering,
University of Moratuwa.

.....

Mr. S Pathinather
Supervisor
University of Moratuwa.

.....

Dr. S.C Wijerathne
Supervisor
University of Sri Jayewardenepura